National Defense Center for Energy and Environment

Selection of Alternative Particle Filtration Designs to Reduce RDX Losses in Dewatering Operations

Roger Williams, BAE Systems

Benjamin Smolinski, PEO AMMO

Brandon Quesinberry, BAE Systems

DoD Executive Agent

Office of the Assistant Secretary of the Army (Installations and Environment)

The NDCEE is operated by: CTC Concurrent Technologies Corporation

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **JUN 2010**	2. REPORT TYPE	3. DATES COVERED **00-00-2010 to 00-00-2010**

4. TITLE AND SUBTITLE **Selection of Alternative Particle Filtration Designs to Reduce RDX Losses in Dewatering Operations**	5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **National Defense Center for Energy and Environment (NDCEE),Concurrent Technologies Corporation,100 CTC Drive,Johnstown,PA,15904**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
Presented at the NDIA Environment, Energy Security & Sustainability (E2S2) Symposium & Exhibition held 14-17 June 2010 in Denver, CO. U.S. Government or Federal Rights License

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**32**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

Acknowledgements

- Mr. Don Yee, Armament Research, Development and Engineering Center (ARDEC)
- Mr. Gregory O'Connor, Project Manager for Joint Services (PM JS)
- Mr. Michael Vestal, Holston Army Ammunition Plant (AAP)
- Mr. Jeff Dill, BAE Systems OSI
- Mr. Bill May, BAE Systems OSI
- Mr. Bill Miller, BAE Systems OSI
- Mr. Bob Winstead, BAE Systems OSI
- Mr. Charles Zimmerman, BAE Systems OSI
- Mr. Paul Brezovec, Concurrent Technologies/NDCEE
- Ms. Jess Grembi, Concurrent Technologies/NDCEE

Holston Army Ammunition Plant (AAP) Description

- Falls under the Joint Munitions Command and is a government-owned, contractor-operated (GOCO) facility
- Manufactures a wide range of secondary detonating explosives including Research & Development eXplosive (RDX), High Melting point eXplosive (HMX), Triaminotrinitrobenzene (TATB), Nitro Triazolone (NTO), and related formulations
- U.S. Army Production Plant for Energetic Explosive Materials

Background

- Morristown 50 miles downstream of Holston Army Ammunition Plant (AAP) uses Holston River as their drinking water source
  - Center for Health Promotion and Preventive Medicine (CHPPM) determined in 2005-2006, RDX level at Morristown meets standards of <2 parts per billion (ppb)
- New municipal drinking water intake proposed for Church Hill, 5 miles downstream of Holston AAP must meet same <2 ppb RDX limit

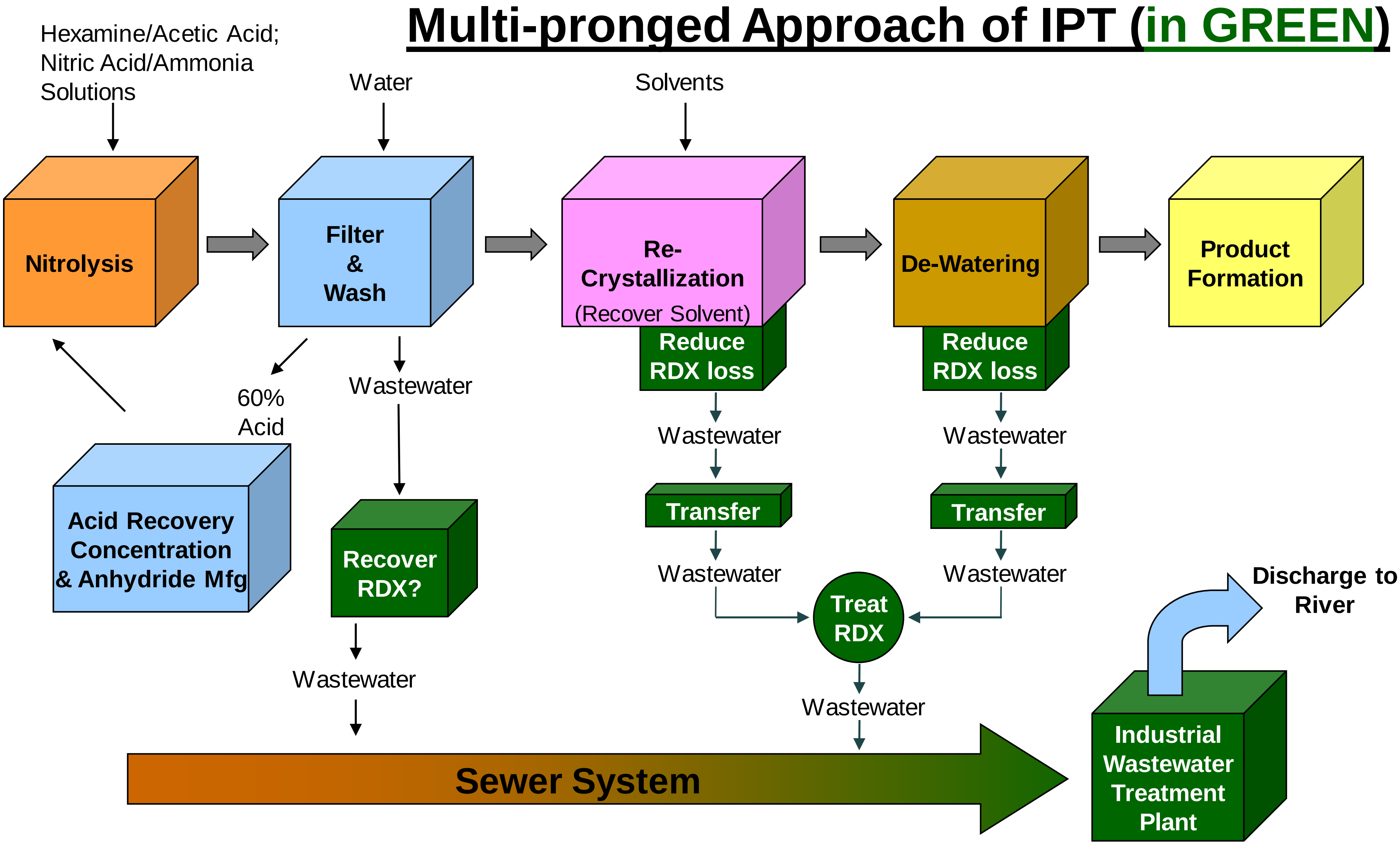
Problem Statement

- Motivated by the newly proposed Church Hill drinking water plant, the State of Tennessee has proposed a <12.2 pounds (lbs) RDX per day discharge permit limit for Holston AAP with a 5-year implementation schedule
- The current RDX manufacturing process sends up to 90 lbs of unrecovered (sparingly soluble) RDX per day through wastewater treatment
- **The RDX in wastewater is lost product!**

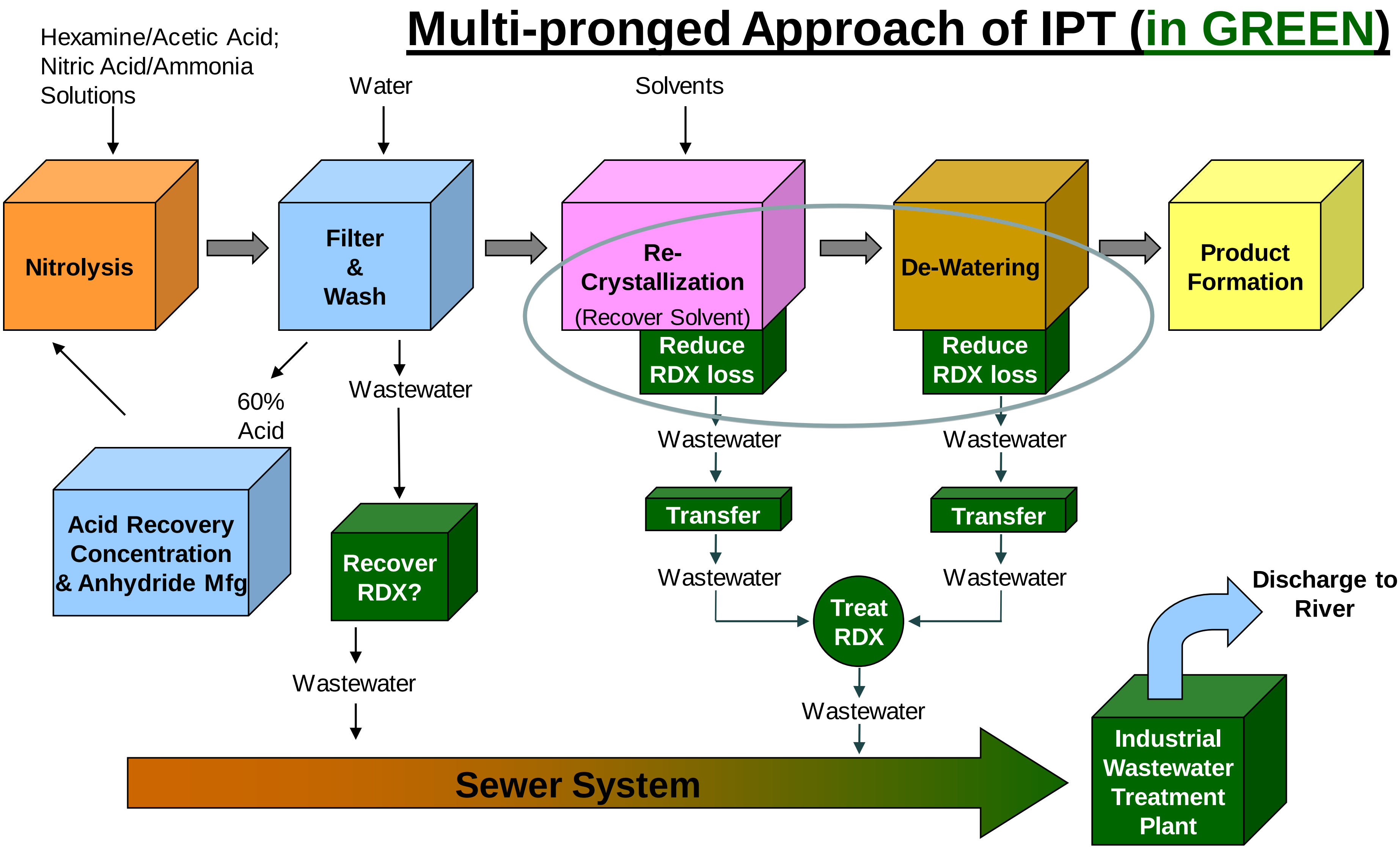
Integrated Process Team Approach

- Apply system approach to identify problem in each phase of RDX manufacturing, including final treatment:
  - Manufacturing and Handling Operation
  - Recovery (Pollution Prevention)
  - Treatment (New Technology)
  - Integration of total operation
- Identify specific nature of the problem
- Evaluate current IWTP operations to determine efficiency of dilute, dissolved RDX removal
- Evaluate manufacturing process to determine minimization of RDX entering wastewater stream
- Evaluate additional treatment options for concentrated RDX (prior to mixing with other waste streams at IWTP)

Project Focus Area: RDX Manufacturing



Focus of This Presentation: Reduce RDX Loss



Identify Specific Nature of the Problem

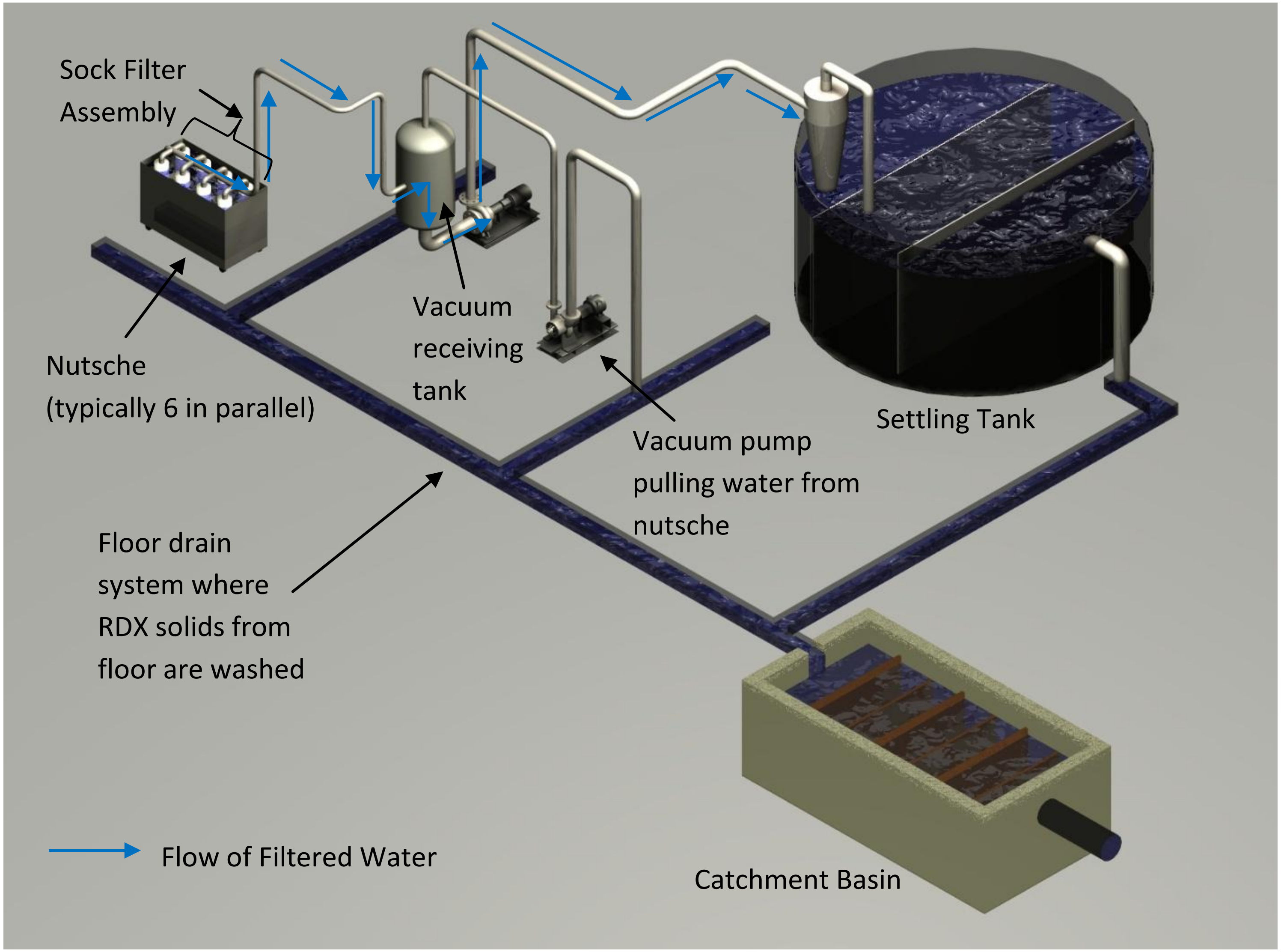
- Study to determine sources of RDX in wastewater

Solids dropping from sock probes were being washed into wastewater stream

Consensus to eliminate solids dropping onto floor

BAE Systems OSI had previously designed a modified nutsche without the problematic sock probes and tested it on a small scale with good results. They then designed two updated versions.

Dewatering Process Overview



Design Alternatives

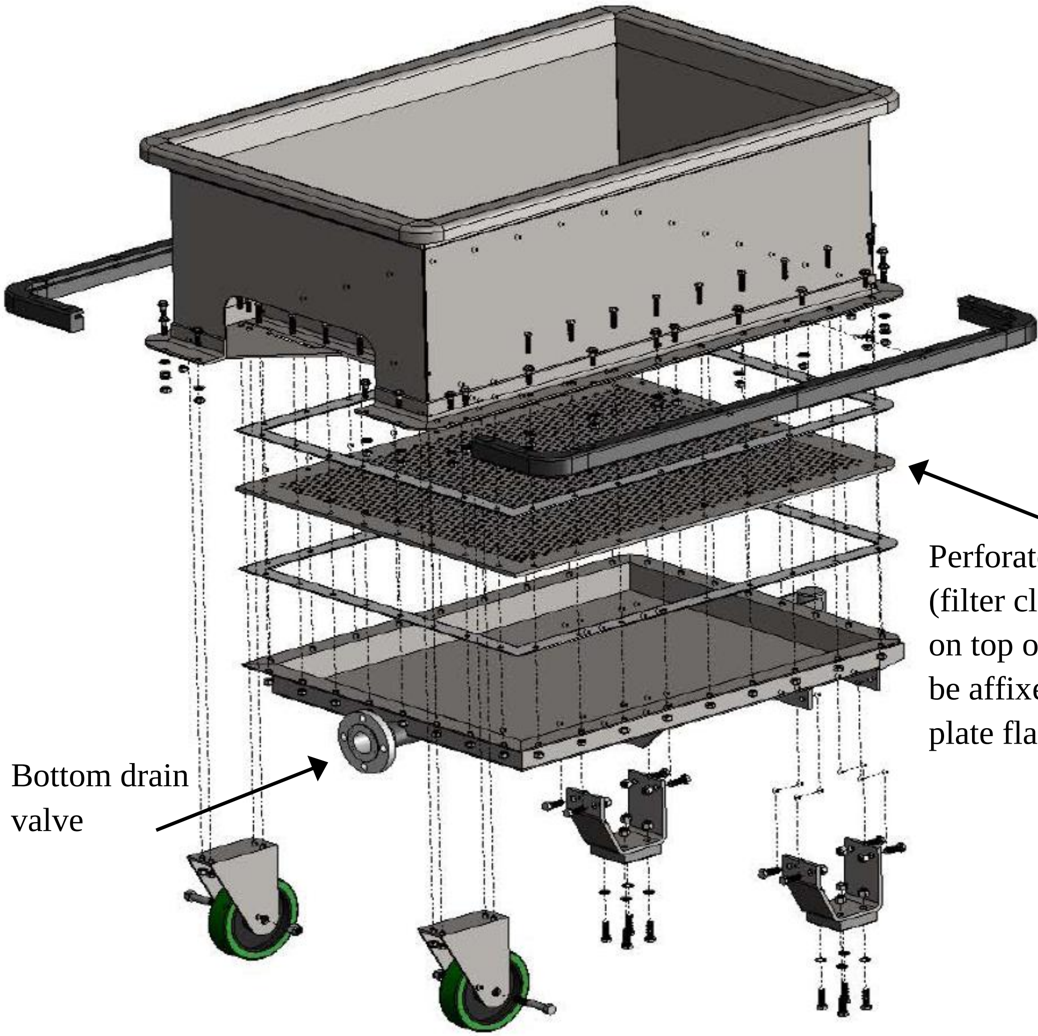
- 4 different alternatives are evaluated in this demonstration/validation (dem/val) project
- 2 have already been used in the RDX manufacturing process at Holston AAP
  - Design #1: Status Quo
  - Design #4: Grid Bottom with Gooseneck
- 2 prototypes were designed by BAE Systems OSI and constructed for this dem/val
  - Design #2: False Bottom Nutsche
  - Design #3: Grid Bottom Nutsche

Design #1: Status Quo

- Noted Problems
  - Non-uniform drying of RDX
  - Water heel in nutsche bottom
  - RDX solids falling to floor

- Noted Advantages
  - Familiarity with it in production

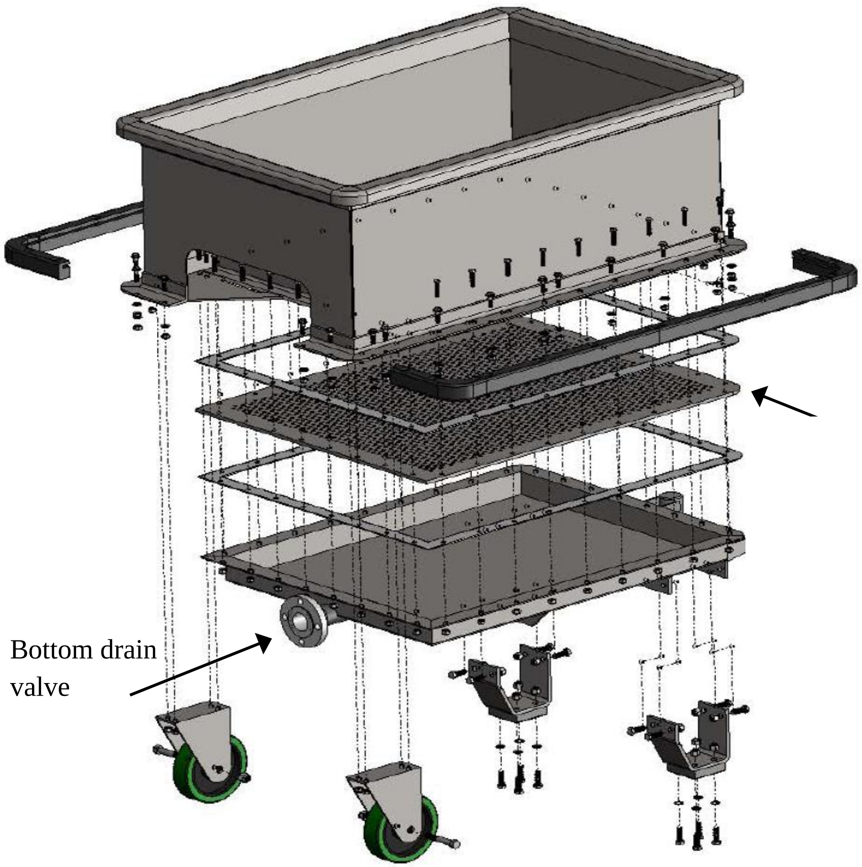
Design #2: False Bottom Nutsche



Perforated plate (filter cloth will lay on top of plate and be affixed to outside plate flange)

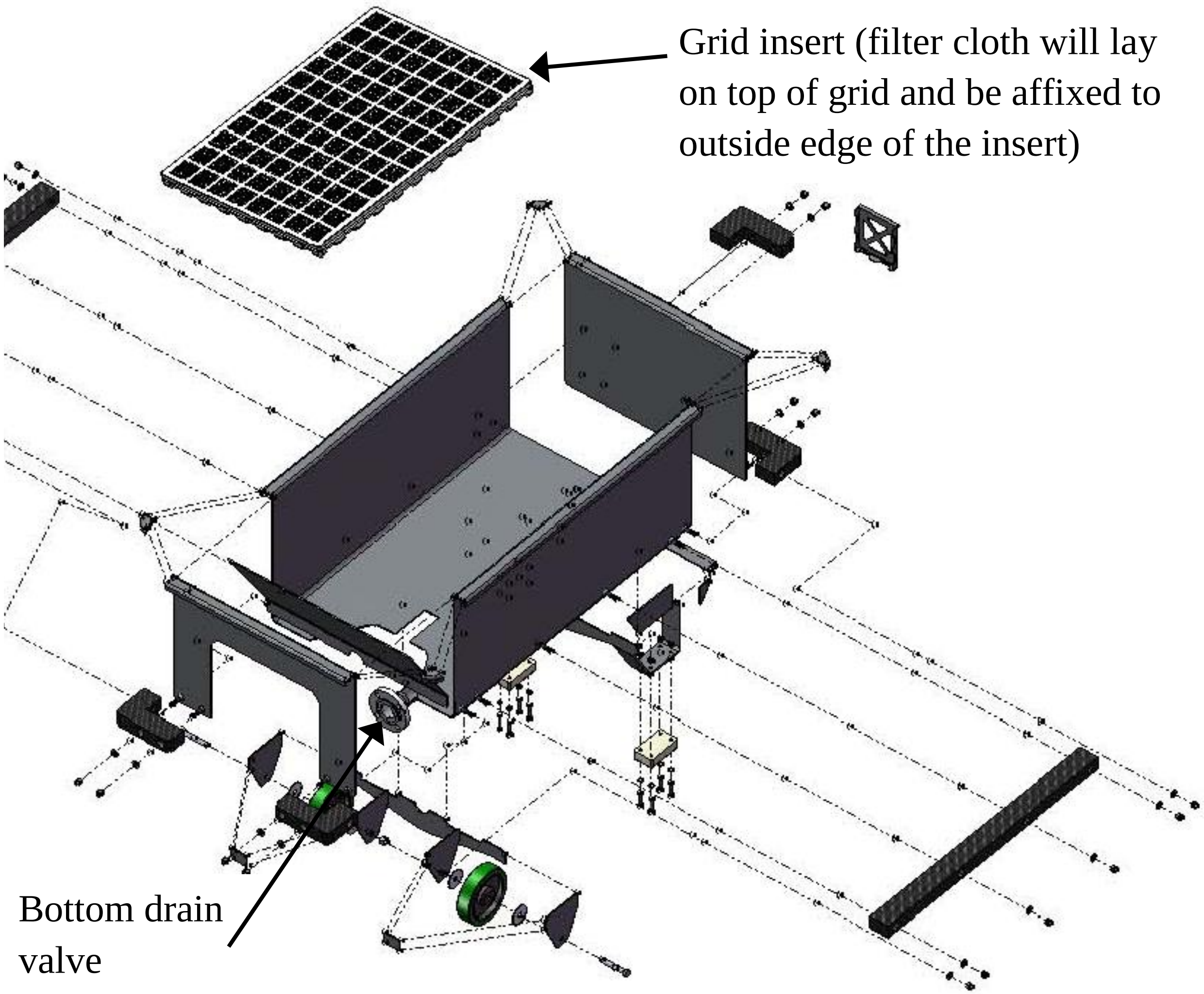
Bottom drain valve

Design #2: False Bottom Nutsche

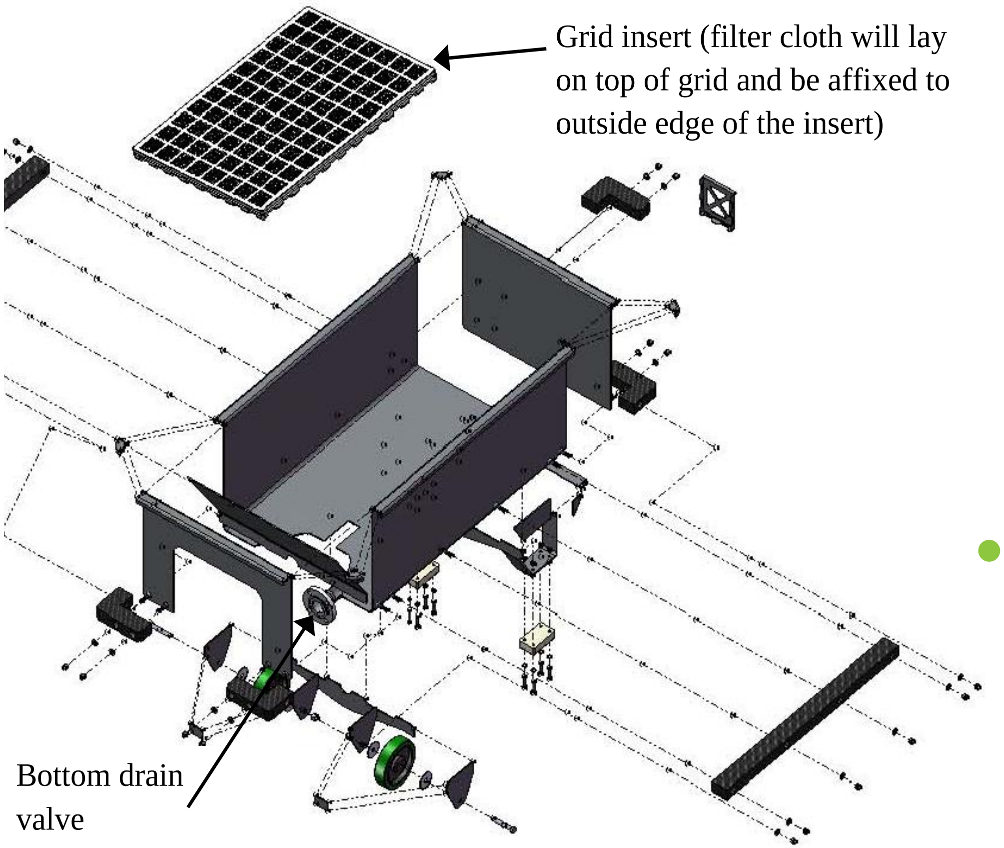


- Noted Problems
  - Mechanics are needed to change filter media
  - Additional care needed to not damage filter when removing cake residue
  - Fines migrate to bottom
- Advantages
  - Larger vacuum line, and does not lift over nutsche
  - Positive seal similar to other equipment in AAP

Design #3: Grid Bottom Nutsche



Design #3: Grid Bottom Nutsche



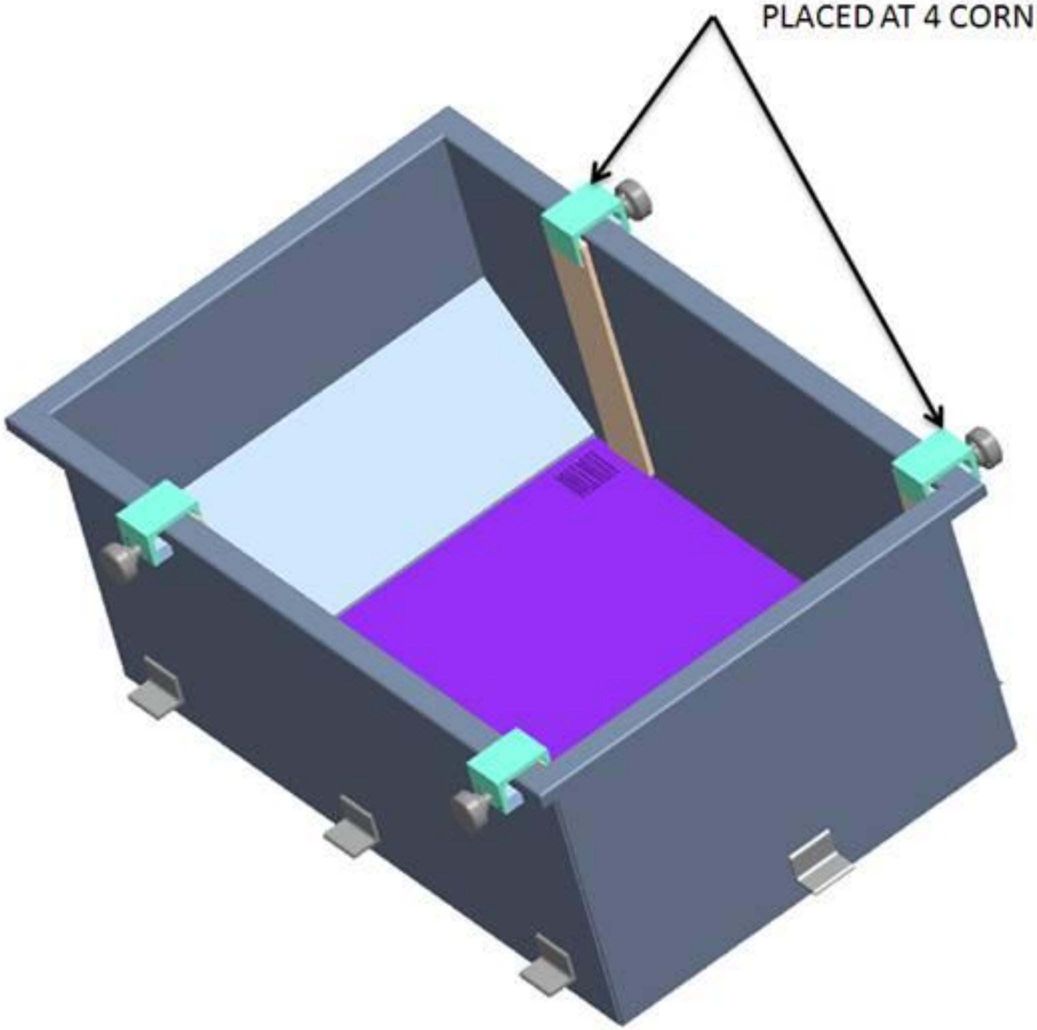
- Noted Problems
  - Filter media seal may leak around grid insert perimeter
  - Additional care needed to not damage filter when removing cake residue
  - Fines migrate to bottom
- Advantages
  - Larger vacuum line, and does not lift over nutsche
  - Filter media change-out by operations, not mechanics

Design #4: Grid Bottom with Gooseneck

Design #4: Grid Bottom with Gooseneck

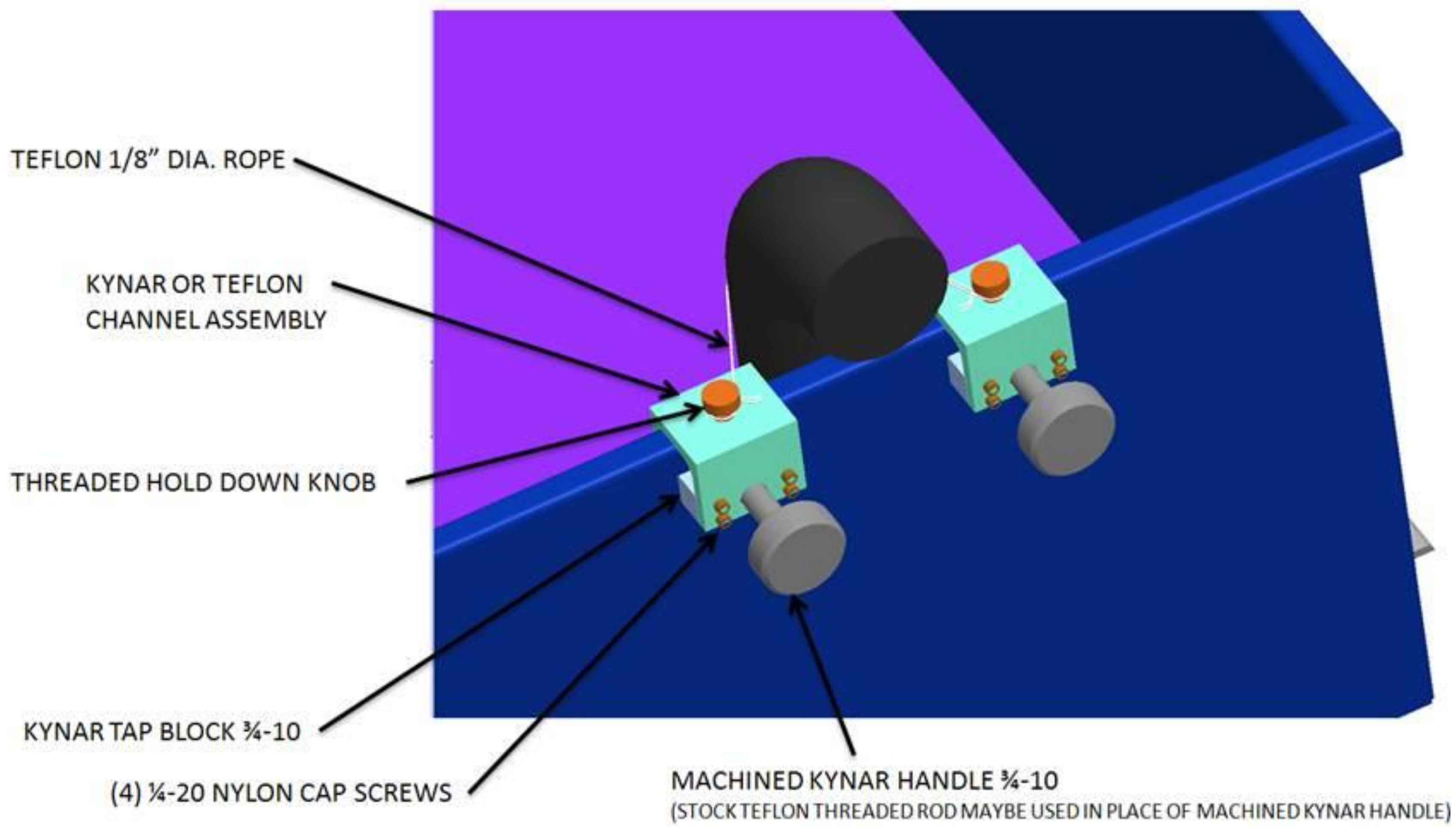
- Noted Problems
  - Additional care needed to not damage filter when removing cake residue
  - Fines migrate to bottom
- Advantages
  - Gooseneck insert will fit all existing nutsches (large cost savings driver)
  - Filter media change-out by operations, not mechanics

Designs #3 or #4: Grid Hold-down Sketch



- Clamps hold brace for securing the grid to the base of the nutsche
- Materials are all plastic
- Can be used for either Designs #3 or #4
- Allows these designs to be mechanically emptied

Design #4: Gooseneck Hold-down Sketch



Qualifying Test Run

- Designs #1 & #4 already used on-site at Holston AAP
- Designs #2 & #3 prototypes manufactured and delivered
- For Designs #2 & #3, safety evaluation procedures had to be followed to allow for use of new equipment in process
  - Prototype validation and familiarization
  - Safety Team review
  - Static test run
  - Transport test run

Qualifying Test Run in Agile Building

	Status quo	False bottom	Grid bottom	Gooseneck
Feed Time	1X	~1X	~1X	~1x
Dewater Time #1	1X	0.9 X	> 1X	---
Dewater Time #2	1X	0.6 X	>1X	---
Dewater Time #3	1X	0.8 X	>1X	---
Dewater Time #4	1X	0.6 X	>1X	---
Time (Averaged)	1X	0.7 X	>1X	0.5 X
Determination	---	Second Best	Fix Design	Best to Date

Qualifying Test Run Lessons Learned

- Sealing corners was difficult on Design #3 (Grid Bottom)
- O-ring vs. Gore-Tex® only seal

More Lessons Learned

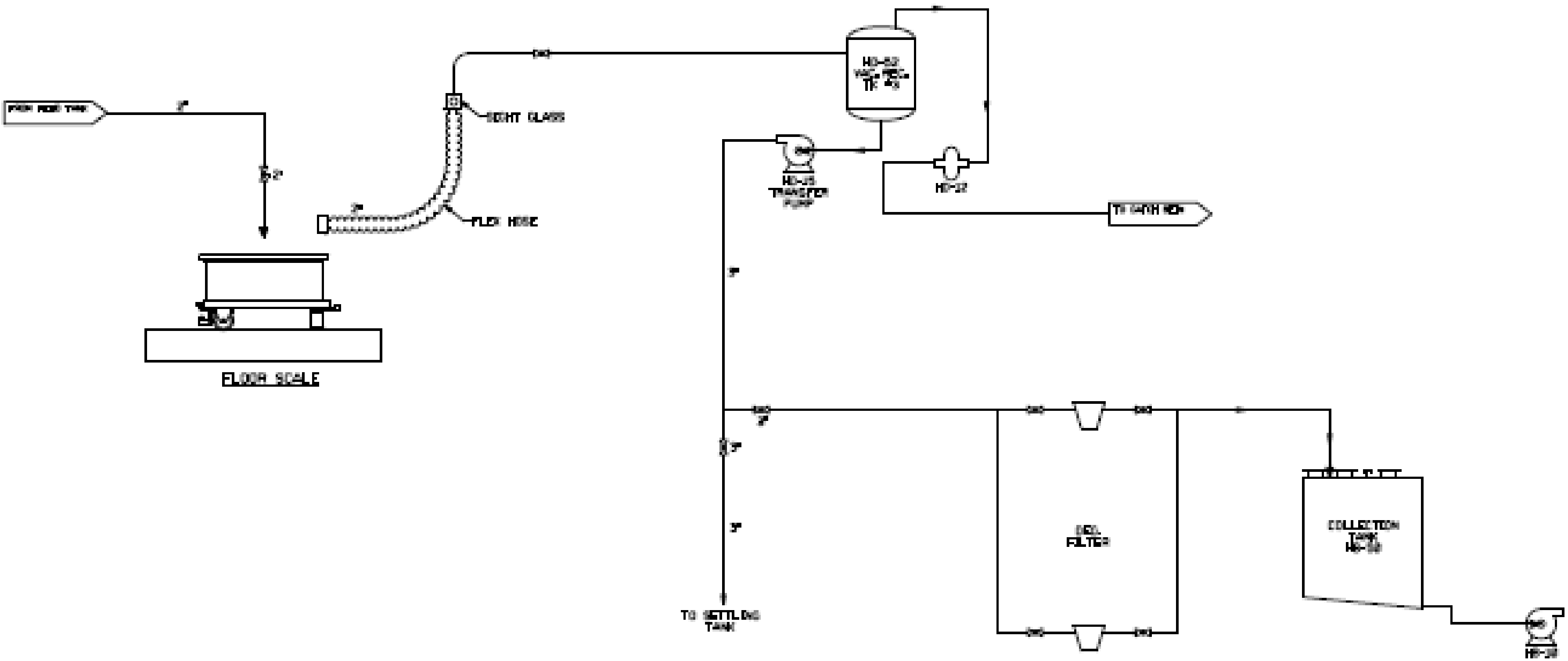
- Torque requirements need to be established for flanges where top and bottom pieces are secured for Design #2 (False Bottom)

- Filter fabric restricting flow thru bottom drain; new method to secure fabric required for Design #3 (Grid Bottom)

Dem/Val Testing

- Phase I: Evaluate RDX Dewatering Efficiency
  - Evaluate moisture removal
  - Evaluate processing time to dewater RDX batch
  - Evaluate RDX concentration reduction in water (yield)
  - Evaluate quantity of RDX solids falling to floor/ending up in wastewater
  - Evaluate additional dewatering after transport
  - Evaluate time to dewater RDX per pound of material
  - Evaluate uniformity of dewatering within locations in the cake (corners vs. middle, and top vs. bottom)

Dewatering Test Setup



Dewatering Test Setup

Dewatering Results

	Status Quo	Gooseneck	False bottom	Grid bottom
Feed Time	Insert data…	Insert data…		
Feed Weight	Insert data…			
Vacuum Pressure				
Solids Lost				
Dewatering Time				
Product Weight				Insert data…
Product Moisture			Insert data…	Insert data…

Dem/Val Testing (continued)

- Phase II: Assess Operations and Maintenance Impacts
  - Estimate quantity of water used in floor cleanup
  - Estimate quantity of water used in sock probe hydraulics
  - Determine optimal dewatering time
  - Determine impacts to next process steps (drying time)
  - Determine time to filter fouling
  - Determine filter's useful life
  - Assess impacts to vacuum pump
  - Other Operations and Maintenance (O&M) impacts (as determined during testing)

Pugh Matrix for Nutsche Study

	Status Quo	Gooseneck	False bottom	Grid bottom
Moisture Level	Insert data…	Insert data…		
Time-to-Dry / Pound of RDX	Insert data…			
RDX on Floor				
Downtime for Maintenance				
Filter Cleaning Time				
Shoveling Time				Insert data…
Normalized Cost			Insert data…	Insert data…

Outcomes

- Due to testing, Designs #X, #Y, and #Z will provide a more uniform dewatering of RDX and possibly reduce the time required for dewatering and drying
- If one of the new nutsche designs is implemented:
  - Water savings will be realized by eliminating the hydraulic lifts for the sock probes (estimated at 6,000 gallons per day per building) and also in house keeping operations to clean up RDX from the floor
  - Lower wastewater volume, which should have an additional cost savings to Holston AAP
  - Lower concentration of RDX in wastewater stream
- Selected Design ---

National Defense Center for Energy and Environment

DoD Executive Agent

Office of the Assistant Secretary of the Army (Installations and Environment)

www.ndcee.ctc.com

Points of Contact

- **NDCEE Technical Monitor**
  TM Name: Donald Yee
  TM Organization: ARDEC
  Phone: 973/724-6286
  Email: donald.w.yee@us.army.mil

- ***CTC* Project Manager**
  PMt Name: Paul Brezovec
  Phone: 814/269-2844
  Email: brezovec@ctc.com

This work was funded through the Office of the Assistant Secretary of the Army (Installations and Environment) and conducted under contract W74V8H-04-D-0005 Task 0473. The views, opinions, and/or findings contained in this paper are those of the author and should not be construed as an official Department of the Army position, policy, or decision unless so designated by other official documentation.